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Observations of enclosed and free-ranging grey kangaroos *Macropus giganteus*

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Introduction

The eastern grey kangaroo, *Macropus giganteus*, is a species of large kangaroo which inhabits the forests of coastal and inland eastern Australia from Queensland to Tasmania.

Work has been carried out on various aspects of the ecology of the species (e. g. KIRKPATRICK, 1965 a, b) and the reproductive biology has been investigated (KIRKPATRICK, 1965 c; POOLE and PILTON, 1964, and CLARK and POOLE, 1967). Apart from some casual observations by CAUGHLEY (1964) and a popular book by BREEDON and BREEDON (1967), little has been done concerning the behaviour of the grey kangaroo in the wild, although aggressive interactions of a group of zoo animals were studied by GERMANN-MEYER and SCHENKEL (1970).

CAUGHLEY (1964) and KIRKPATRICK (1966) maintained that sociality in the species was restricted to the relationship between the mother and her young. The present study was initiated in an attempt to elucidate further the social organisation in this species which is described as *gregarious* by several authors (e. g. MARLOW, 1962). This paper describes the general behaviour of the grey kangaroo in captivity and in the field, and a more detailed account of sociality in the species is considered elsewhere (GRANT, 1973).

Materials and methods

In order to gain some basic, quantitative and descriptive data on the behaviour of the eastern grey kangaroo (*Macropus giganteus*) observations were carried out on both captive and free-ranging animals.

Seven adult kangaroos (1 male and 6 females) were observed for 12–14 hours at a time, making up 5 complete 24 hours periods during: June–July, 1971; September–October, 1971; January–February, 1972.

These animals were kept in an enclosure of approximately 550 m square at the Cowan Field Station of the University of New South Wales. They were fed lucerne hay and poultry pellets from separate food hoppers in the enclosure and were watched from an observation tower situated a few yards from the enclosure.

During the night hours dim lighting was supplied by three red filtered, 200 watt lamps placed around the fence of the pen. The animals were fitted with white collars which allowed them to be seen more easily. Reflective symbols (EALEY, DUNNETT, 1965) rivetted to these facilitated rapid individual recognition.

The captive females were checked monthly for pouch young and these were aged from the measurements of the hind feet and tail (KIRKPATRICK, 1965 b). Two young vacated the pouch during January of 1972 but one of these had to be destroyed in early February.

Only one of the adults had been reared by its mother. The rest had been reared at the field station or elsewhere but were not tame.

In the field a group of 13 to 23 kangaroos were observed when they were feeding on a small grassy flat in the Nadgee Nature Reserve on the south coast of N.S.W. (approx.

37° 25' S 49° 58' E). The group consisted of 3 mature females, 3 young at foot and a variable number of mature males. Observations were made using 7 × 50 field glasses and although none of the animals were marked most could be recognised individually by their natural markings, coat colour and size. The full moon provided most of the light necessary for night observations and additional light was supplied from a redfiltered spotlight. As in the work with the captive group, data was recorded on a portable tape recorder or check sheets.

Various aspects of behaviour were recorded at intervals of 15 minutes. The number of animals feeding within each 15 minute period was noted in the wild as well as in the captive group, but in general observations were scored and timed in the field as they occurred.

Results and discussion

1. Maintenance and general activities

The times spent in a variety of activities by animals in captivity are shown in Table 1.

Table 1

Percentage time spent in various activities by the captive group of kangaroos

	June—July 1971		Sept.—Oct. 1971		Jan.—Feb. 1972	
	Day	Night	Day	Night	Day	Night
Feeding	25.8	25.2	17.4	24.3	12.6	28.5
Drinking	1.3	1.0	0.8	0.8	0.5	0.8
Moving	3.0	3.3	1.7	2.0	0.0	0.0
Grooming	6.3	7.0	7.9	4.4	1.4	2.5
Standing	1.9	0.9	0.1	0.0	0.0	0.0
Crouching	66.8	77.1	60.3	74.5	59.9	77.5
Lying	30.4	14.4	35.9	23.1	40.0	22.3

Crouching and lying, which are mutually exclusive, were the most common activities of the animals at all seasons. Crouching was a posture in which an animal was inclined below the vertical (standing). A number of positions were covered by this criterion which included a low crouch, with the front paws on or near the ground, a medium crouch which was the most common posture adopted and the high crouch, taken up when the animal was alerted. Standing was generally adopted after the initial high crouch, and what could be called high standing was adopted just prior to flight. When high standing, the animal was raised onto its "tip-toes", as sometimes occurred while stretching for food at the feeding hopper (Fig. 1b).

Lying generally occurred during the heat of the day when animals either basked in the sun (winter) or lay in the shade (summer). The most common lying position was with the head raised, or even with the whole body raised up on the fore paws (Fig. 1a). Occasionally, however, the head was laid on the outstretched fore paws. Animals closed their eyes in this position for brief periods both at night and during the day. Some of the captive kangaroos also closed their eyes and appeared to sleep in the low crouch position. Fig. 1 shows a number of the stationary positions taken up by the animals in captivity and in the field.

The higher percentage of time spent in lying down during the day as against that at night suggested response to sunlight or temperature and the higher values in spring and summer tend to substantiate this suggestion.

Animals were not usually seen during the day in the field and this alone suggests the existence of a similar pattern of activity to that seen in captivity, with animals

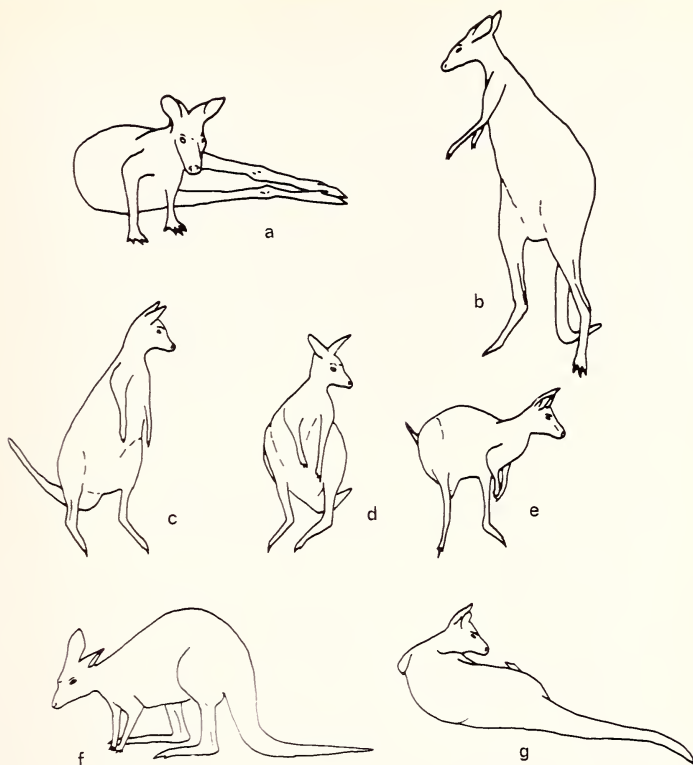


Fig. 1. Stationary positions adopted by grey kangaroos. a = lying with chest and head held up; b = high standing; c = standing; d = high crouching; e = intermediate crouching; f = crouching; g = lying with head up

resting in the bush during the middle of the day and coming out to feed around dusk. Fig. 2 shows the crepuscular feeding pattern seen in both groups. The figures for the field never show 100%, only because all the animals were not visible at all times. The bimodality shown in the enclosures is probably only an artifact produced by the localisation of food sources. In general the patterns are similar, although the wild animals began feeding later than those in captivity. The decrease in time spent in feeding during the day from winter through to summer (Table 1) in the captive group indicate the influence of weather (especially temperature and sunlight) on the diurnal patterns of activity of this species.

Drinking showed no particular pattern in any of the seasons but as summer temperatures in 1972 seldom rose above 30°C it is probable that stress due to evaporative water loss never became severe enough to allow any pattern to emerge during the study.

Micturation occurred in a relatively random fashion but defaecation tended to occur predominantly at feeding places, in the field and in captivity. Little fouling of lying places was observed.

Grooming of the shoulders and neck was carried out mostly by the use of the syndactylus claws of the hind feet, while the animal was crouching or lying on its side. The rest of the trunk was groomed with the fore paws in conjunction with the teeth and tongue. As an animal lay on its side the lower parts of the tail and hind limbs were commonly attended to while being held by the fore paws (Fig. 3b).

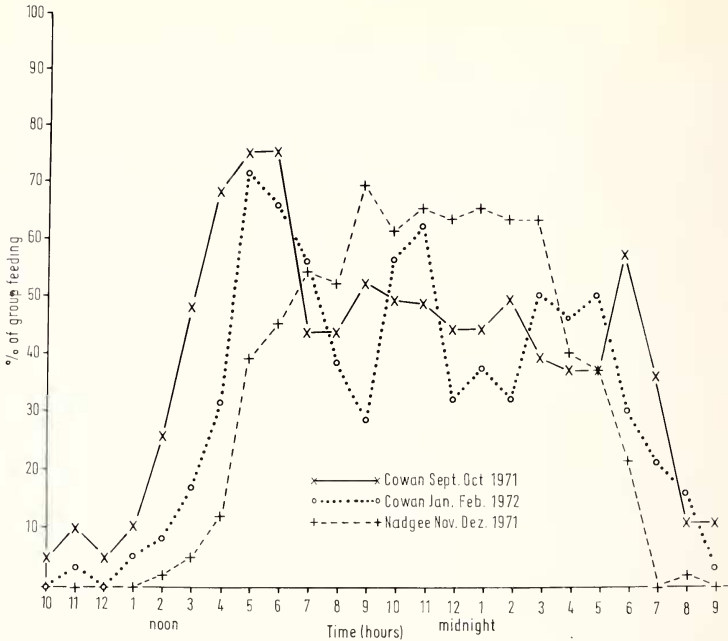


Fig. 2. The mean daily feeding pattern of the captive group of kangaroos during spring and summer and that of the free-ranging group during early summer

Sitting with the tail between the legs was not seen in the animals studied, except in the case of a single male in the field which chewed the tip of his tail in this manner. RUSSELL (1970 a) recorded tail grooming by this method during normal grooming in captive red kangaroos and SHARMAN and CALABY (1964) noted it in pouch cleaning and during birth in the female of the same species.

Females in the yards were seen scratching their chests in exaggerated upward strokes (Fig. 3f) with the whole body arched backwards. This was observed to a lesser extent in wild animals and could possibly be an example of the ritualisation of a groom-activity although its function as a signal is not immediately clear.

Pouch cleaning occurred in all females to varying extents but appeared to be more pronounced in those with pouch young (if pouch cleaning was random in the 66 observations of it for 6 females in the yards in the winter of 1971 the expected would be 11 each; $X^2 = 22.13$, for 5 degrees of freedom $p = < 0.001$). It was interesting to note that female No. 4 in the yards had a pouch young in June but not in July and out of 100 observations of pouch cleaning in this animal only 2 were in July. SHARMAN and CALABY (1964) noted increased cleaning activity in red kangaroos just prior to birth and POOLE and PILTON (1964) indicated similar observations in their study of the grey kangaroo. There are therefore probably three intensities of pouch cleaning behaviour in kangaroos associated with stages of reproduction, the highest intensity being just prior to the birth of the pouch young and the lowest when no young is present in the pouch.

During pouch cleaning the mother was seen to hold out the pouch with one fore paw and to insert her muzzle, while apparently bracing herself by holding the other fore paw in behind her buttock (Fig. 3c). Unlike the red kangaroo the grey kangaroo did not hold the sphincter muscle of the pouch open with both fore limbs (RUSSELL, 1970).

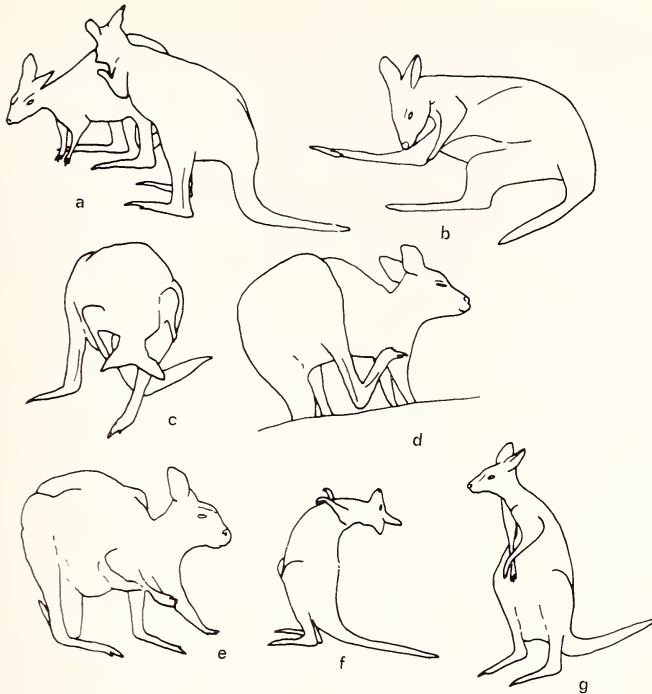


Fig. 3. Grooming behaviour of the grey kangaroo. a = one female grooming the back of another; b = most common manner of grooming hind limbs; c = pouch grooming (note only one fore paw holding pouch open); d = grooming shoulder; e = scratching fore limb; f = "exaggerated" chest grooming; g = grooming of lower abdomen

Mutual grooming and grooming of one animal by another (allo-grooming) occurred between mothers and their young in both situations. In the captive group some adult animals regularly groomed each other (see below).

The low percentage of time spent in movement indicated the sporadic nature of movement which was seen in the yards. In the field the animals moved about much more as they went about the process of grazing. Grazing did not appear to be systematic, and the kangaroos moved variable distances during feeding on consecutive nights. No pattern of usage of specific parts of the feeding area at Nadgee was apparent.

2. Sexual activity

Sexual interactions occurred quite frequently in the captive and field groups of kangaroos. Copulation was only seen once and it appeared that sexual activities occurred at varying intensities whether or not the female was in oestrus. A normal sequence of a sexual interaction can probably be categorised into the stages described for the red kangaroo by SHARMAN and CALABY (1964); i. e. investigation, following and copulation. A typical sequence can be described thus:

- The male approached the female (usually with his penis erect) and either
- sniffed her genital regions while standing beside her or
- moved in front of her and rubbed his chest on her head, or grasped her head and forced it against his chest (chesting).
- If the latter occurred the female sometimes pawed at the chest of the male or groomed his chest and neck.

- e. After this the male normally moved behind the female and began patting the tip (in the wild) or the butt (in the pens) of her tail (tail patting).
- f. In response to this the female moved away in short bounds and the male followed and persisted with the tail patting (following).
- g. This following was often quite prolonged and lasted up to 30 minutes in the field on several occasions, with the animals moving at the run over a considerable area.
- h. Following was normally terminated by the male.
- i. In the copulation observed the male stood astride the female from behind and held her deep in the thighs in much the same way as described by SHARMAN and CALABY (1964) for the red kangaroo. The male remained mounted for 10 minutes and the copulation was terminated by the female rearing up. No further activity occurred but the appearance of a new young in the pouch of the female 30–40 days later suggested that the copulation had been successful.
- j. soft "clucking" vocalisations by the male accompanied all sexual activities.

In the captive group the sexual activities of the male did not seem to bear any relationship to the reproductive condition of the female. Vaginal smears were not done but inferences could be made about the females from the presence, absence or state of development of the pouch young. For example female No. 7 was involved in the most sexual interaction in September of 1971 (52). At this stage she had a pouch young of 240 days and as oestrus does not recommence until 2–4 weeks after permanent vacation of the pouch (POOLE, PILTON, 1964; KIRKPATRICK, 1965; CLARK, POOLE, 1967) it is very unlikely that this female was in oestrus during September. On the other hand at this time female No. 8 had little contact with the male (10) but obviously came into oestrus at that time as one of the interactions resulted in a successful copulation.

POOLE and PILTON (1964) suggested that pouch cleaning increased in the female grey kangaroo just prior to oestrus. In this study no correlation could be found between ranked sexual activity in the captive females and ranks of observed pouch cleaning (Table 2). During the period in which female No. 8 came into oestrus she ranked last in the recorded instances of pouch cleaning, suggesting that this is probably not a satisfactory indication of the approach of oestrus in the grey kangaroo.

In the group at Nadgee association between males and females was correlated (Table 3) to sexual activity, suggesting that sexual association may have been the strongest bond between males and females in the group. No such correlation existed in the case of the single male in the enclosure however.

No relationship could be found in the free-ranging group between the dominance rank in males and their sexual activity (r_s 0.545 $p > 0.05$). Preference of access of males to females therefore did not seem to be the function of the system of dominance found in the group. This apparent anomaly may be due to the fact that sexual activity occurred in the absence of females actually in oestrus. GERMANN-

Table 2

Correlations between pouch cleaning and sexual activity in the captive kangaroos

	r_s^1	p	Significance ²
June—July 1971	0.799	> 0.5	N. S.
Sept.—Oct. 1971	0.824	> 0.5	N. S.
Jan.—Feb. 1972	0.446	> 0.5	N. S.

¹ SIEGEL, 1957.
² N. S. = not significant; S. = significant at 0.05; H. S. = significant at 0.01.

Table 3

Correlations between association of males with females and sexual activity in both captive and free-ranging kangaroos

		rs	p	Significance
Nadgee	Nov.—Dec. 1971	0.856	< 0.01	H. S.
Cowan	June—July 1971	0.251	> 0.05	N. S.
	Sept.—Oct. 1971	0.688	> 0.05	N. S.
	Jan.—Feb. 1972	0.741	> 0.05	N. S.

MEYER and SCHENKEL (1970) found a hierarchy among male grey kangaroos which was related to sexual privilege and it is possible that in the wild access to *oestrus* females may be a function of dominance.

Any attempt to rank the intensity of interactions must be purely subjective and the shortness of the pre-copulatory following and investigation in the copulation observed showed the futility of any such ranking.

Investigation and chesting is probably related to the use of scent glands in sexual arousal. MYKYTOWYCZ and NAY (1964) found most apocrine secretory glands in the chest and axillary region of male kangaroos and in the cloaca and pouch region of females. They suggested territorial marking and recognition of the young as possible functions of these glands. The present study showed no evidence of marking of objects by males and although I have seen males in captivity chesting against fences, I suggest that the secretions of these glands are more important in sexual activities.

3. Aggressive activity

Grey kangaroos showed a low level of aggression even under the conditions of close proximity in the enclosure (0.12—0.18 decisive aggressive encounters/animal/hour). Under these conditions with only one male present most interactions involved only females. The male was never aggressive unless provoked and was seldom beaten in an encounter. A pattern of dominance developed between the females in which the two largest females were dominant, one over the other and both over the rest of the group.

The group at Nadgee had only 5 females in it, two of which were the young at foot of one of the adults. This tended to dilute any pattern of relationship but the mother of the young tended to dominate the whole group (GRANT, 1973).

Female-female aggression was restricted to animals rearing up and cuffing at each other's necks and chests (Fig. 4a) with their fore paws. What appeared to be more intense aggression was accompanied by loud vocalisations. These sounded like a prolonged cough and very often occurred when a female delivered kicks to her opponent. These kicks were delivered to the side of the opponent while the aggressor balanced on her tail and grasped the fur on the other animal's back. This type of kicking was different from that seen in male-male encounters.

Aggression between males and females was not common in the captive animals and practically non-existent in the free-ranging group. Occasionally a female would cuff at a male to discourage sexual advances but even this was rare. Interactions between juveniles of both sexes were seen in the field but in most instances it was difficult to distinguish between fighting and play. Aggression of females towards the young of others did not seem to develop until the young had left the pouch. During

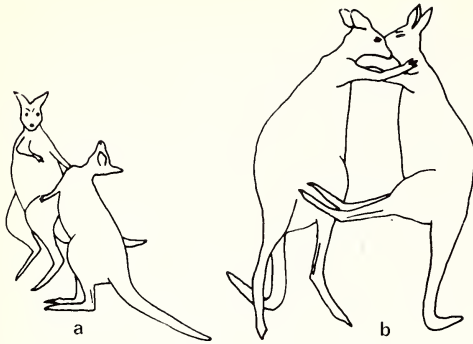


Fig. 4. Aggressive interactions between grey kangaroos. a = cuffing in a female-female encounter; b = grasping and "tail-kicking" in a male-male interaction

pouch life when the young had their heads out of the pouch other females with less developed pouch young often tried to groom these young and were repulsed by the mothers. After the young left the pouch however they were regularly cuffed and even kicked by other females. Juvenile No. 9 was involved in 24 encounters in 72 hours of observation and juvenile No. 10 in 45 in 98 hours. Usually the young moved off rapidly after a brief cuff or vocalisation by another animal, but as No. 9 lost condition (as the result of infection) she lay down whenever attacked. This seemed to incite the attacking female which then usually proceeded to kick her. No such behaviour was recorded in the field and it is possible that this was an artifact produced by the proximity in captivity. Despite this such an incident indicated that retreat was an expression of submission and inhibited further attack.

Encounters between males in the wild were quite spectacular and prolonged but were also considerably ritualised. The males in the group at Nadgee appeared to have a hierarchy which was maintained by a few of these encounters (GRANT, 1973).

These fights occurred mostly in the late afternoon and at night and the full sequence can be described thus:

- a. The males faced each other and one, or both adopted a high standing posture. The fore arms and chest were sometimes licked and were flexed in front of the chest or above the head.
- b. A crouch was then normally adopted and noses or fore paws were touched.
- c. The animals remained in a crouched position for varying lengths of time until one reared up and made the first contact.
- d. Cuffing by both males at each other's chests then began, attempts at grasping about the neck were made and a series of tail kicks were usually delivered by both animals (Fig. 4b).
- e. After a minute of contact both broke off and began to scratch their sides in an exaggerated fashion (BREEDON and BREEDON, 1967) or one would break off and scratch while the other went into a low crouch. The latter often led to the crouching animal beginning to feed or moving away a few paces. The former led to a resumption of d.
- f. The animals seldom stayed in the same place but move over quite an area while fighting.
- g. The sequence was normally terminated by one animal (the loser) bounding off or moving away a few steps to continue feeding.
- h. Vocalisations like those described for the females accompanied most of the bouts.

Some fights lasted up to 10 minutes. Out of the 67 male-male encounters observed only 32, were classed as decisive, consisting of an approach and a retreat.

These fights mostly took place when two males came together while feeding and consisted of various parts of the sequence described above, with grasping and kicking being the main features noted.

4. Mother-young interactions

The bond between a young grey kangaroo and its mother lasts for two years from birth in the female, and around 18 months in the male. During this time the young at foot suckles from the mother which may be feeding another young in the pouch. The young

at foot may be suckled for up to 6 months after its vacation of the pouch (KIRKPATRICK, 1965 b).

In both the captive and wild population observed in this study interactions between a mother and her young were restricted to the first month, or possibly two, after premanently vacating the pouch. After this time the relationship became a more passive association in which the young followed the mother and was occasionally groomed by her while feeding.

Table 4 shows the types of interactions which occurred, comparing the wild animals with the captive ones. Pawing consisted of a gentle cuffing with the fore paws by the mother, the young, or both, at each other's chest and neck. Allogrooming and mutual grooming occurred in which a raking action of the fore paws through the fur and nibbling and licking with the mouth were used. In most instances the neck region was groomed but the mother quite often tended to the young's back while it was feeding from the pouch. The young sometimes groomed various parts of the mother while she was crouched feeding.

Running in wide circles out and back to the mother was assumed to be "play" behaviour and occurred during temporary pouch vacation and for a short time (up to a month) after the young had left the pouch completely. The running was always rapid and ended up with the young pawing, grasping, or even fighting the mother. In the latest of these the young sometimes kicked the mother and grasping consisting of an embrace.

Table 4
Mother-young interactions

	Cowan				Nadgee			
	♀ 5/young	♀ 10	♀ 7/young	♀ 9	♀ 1/young	♀ 4	♀ 1/young	♀ 5
Pawing	0		7		0		12	
Allogrooming								
♀/young	12		8		0		0	
young/♀	5		2		0		1	
Mutural Grooming	0		2		0		9	
Running	2		0		0		4	
Fighting	3		1		0		0	
Grasping	0		2		1		10	
Feeding	114		39		0		4	
Hours observ.	120		72		137		137	

These various interactions were often seen combined in different combinations, occurring during feeding from the pouch or after the young animal returned from feeding away from the mother. In the enclosure grasping and grooming usually occurred if the young had been chased by another female.

Feeding from the mother was tremendously variable both in the number of feeds and the duration of these (Table 5). A young was presumed to have been feeding if it had its head in its mothers pouch. RUSSELL (pers. comm.) had indicated that this may not always be true however as she observed the young of a tammar wallaby (*Macropus eugenii*) with its head in the pouch of a female which was known to have no milk. This may account for the great variability in the feeding which was observed in this species. The mothers broke off most of the periods of feeding except for very long ones where the young usually moved off of its own accord. Few instances of suckling were seen in the free-ranging animals and it is possible that most of this occurred before the animals emmerged to feed in the open.

Table 5

Time spent and number of times young of the captive kangaroos fed from their mothers

Day	No. feeds (total)		No. terminated by young		Time feeding (hrs)		Mean %/hr. feeding	
	♀ 9	♀ 10	♀ 9	♀ 10	♀ 9	♀ 10	♀ 9	♀ 10
1	5	21	3	7	0.45	0.63	3.8	5.1
2	6	22	4	3	1.15	1.22	9.6	10.2
3	8	10	7	3	1.54	0.99	12.8	8.2
4	5	7	2	2	1.36	0.87	11.3	7.2
5	3	22	1	5	0.58	1.67	5.3	15.2
6	9	10	3	1	2.08	1.92	14.9	13.7
7	—	11	—	2	—	1.63	—	12.7
8	—	6	—	0	—	0.99	—	7.1
9	—	3	—	0	—	0.40	—	3.6
10	—	3	—	0	—	0.74	—	7.4

A mature female, observed in an earlier trip to Nadgee, had disappeared from the group at the time of the study, leaving her male young at foot. This animal was not observed feeding from the mother of the other two young but it followed the female around as much as her own young did. Fostering of young at foot has not previously been reported in the field but KIRKPATRICK (pers. comm.) has found such fostering in captive kangaroos, even at an interspecific level.

The protracted nature of the mother-young bond could facilitate learning in the juvenile but a reduction of contact after the first month after pouch vacation does not support this suggestion. RUSSELL (1970a) found such a decrease in mother-young interaction in the red kangaroo and her observation that the maintenance of the relationship appeared to become increasingly the responsibility of the young seemed to be paralleled in the grey kangaroo.

5. Other behaviour

Although not observed between adults in the field, both allogrooming and mutual grooming were seen in the enclosure. This grooming was carried out, as in the normal maintenance behaviour, by raking, licking and nibbling of the fur. The most commonly groomed areas were the neck and shoulders, but the ears were also frequently attended to.

Two pairs of females were mostly involved in this behaviour but it was not restricted to these individuals. The interactions between females 3 and 4 quite often took on many of the characteristics of normal sexual behaviour and could have been homosexuality. Such behaviour was not seen in the wild but homosexuality, including mounting attempts was occasionally seen.

In captivity the interactions between females 2 and 5 (Fig. 5) however showed none of these elements and their behaviour can possibly be cited as evidence of a positive relationship between the two animals. A measure of association (GRANT, 1973) also showed that these two pairs of kangaroos were the most closely associated in the group, suggesting the ability of grey kangaroos to form bonds between mature individuals.

Male kangaroos in the field were seen to masturbate on several occasions, usually after prolonged, unsuccessful sexual activity.

Displacement activity is a term often applied to many unexplainable behaviour patterns. It has generally been associated with a conflict of drives and the releasing of some inappropriate pattern of behaviour (VAN IERSEL, BOL, 1958; SEVENSTER, 1961; MCFARLAND, 1966). After a long, unsuccessful pursuit of a female or at a failure to elicit an aggressive response from another male the following inappropriate behaviour was seen in several different kangaroos in the field:

- The male bent down into a low crouch and began to tear grass out with his fore paws.
- He then began to rub his chest and neck on the ground and
- reared into a high standing position with his fore limbs stretched in front of his chest or above his head.
- In most instances erection of the penis occurred during part or all of the display.
- After the upright posture the sequence was either terminated or repeated.

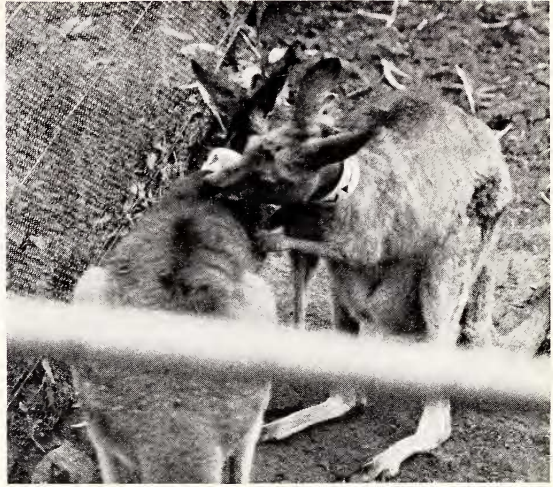


Fig. 5. Mutual grooming between two females in captivity

This display included elements of threat and sexual behaviour in it and could warrant further investigation. Although homosexuality has been reported in one other species of macropod (LA FOLLETTE, 1971) behaviour such as masturbation, homosexuality and what has been called displacement (simply for the want of a better term) have not generally been reported in kangaroos. This probably reflects the lack of observations of these animals, especially in field conditions, rather than the uniqueness of these behaviour patterns to one or two species of the family Macropodidae.

Regurgitation of food was observed in both the wild and captive kangaroos. Regurgitation appeared to be more frequent in the animals at Nadgee than those in the pens. Observations confirmed this (0.21 regurgitations/animal/hour at Nadgee as against 0.018/animal/hour at Cowan). The more easily digested food supplied to the penned animals was probably the reason for the difference observed.

Kangaroos have a semi-ruminant digestion (MOIR, SOMERS, WARING, 1956).

Table 6

Frequency of occurrence of various activities in the captive and free-ranging adult grey kangaroos

	Nadgee Nov.—Dec. 1971	Cowan Sept.—Oct. 1971	Cowan Jan.—Feb. 1972
Allogrooming	not observed	36	17
Mutual Grooming	not observed	27	5
Homosexual	4	not observed	4
Masturbation	4	not observed	not observed
Displacement	9	not observed	not observed
Hours observ.	137	120	120

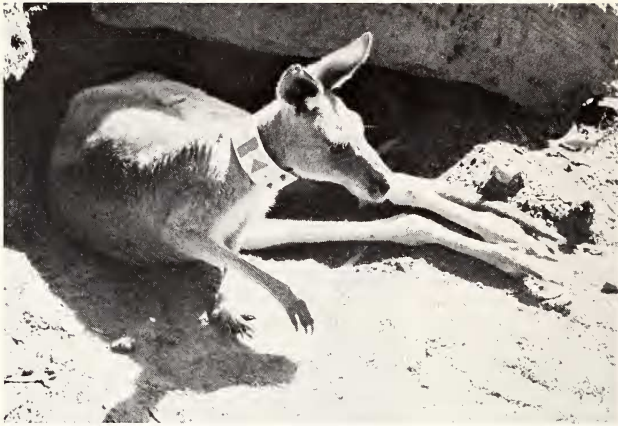


Fig. 6. Kangaroo lying in a depression scraped out at the base of a tree

Regurgitation of food was suggested by MOLLISON (1960) to be analogous to rumination in eutherian ruminants. BARKER, BROWN and CALABY (1963) reported regurgitation in other, non-ruminant marsupials and concluded that apart from this the process did not occur frequently enough to be of importance in digestion. The present study confirmed this conclusion in the case of the grey kangaroo.

During the winter and spring the kangaroos in the pens appeared to have some preference of lying places but these were not rigid and certainly not defended. In summer the animals scraped out depressions in various parts of the enclosure (Fig. 6). These were characteristically occupied by only one or two animals (separately) and a few instances of one animal chasing another from the place usually occupied by it was observed.

The depressions tended to be in the areas of maximum shade and were discrete units. As no such scraping behaviour was seen at any of the other seasons the function of this could have been, as RUSSELL (1970a) suggested for red kangaroos, to clear away the hot surface layers of soil before the animal lay down. This appeared unlikely in the grey kangaroo however, as the scraping was usually done after the animal had lain down. A possible function of the behaviour may be to facilitate heat loss from individual animals by keeping them apart from each other.

Conclusions

The present study indicated that grey kangaroos have behavioural characteristics which are common to all species of the family Macropodidae so far studied.

Diurnal activity patterns were very similar to those seen in the red kangaroo (CAUGHLEY, 1964; GRIFFITHS, BARKER, 1966), the euro (EALEY, 1967) and the quokka (PACKER, 1969). Sexual and aggressive behaviour fitted a general pattern applicable to these species and the red-necked wallaby (LA FOLLETTE, 1971).

The finer detail of the activities described seem to be the only behavioural attributes which are specific to the grey kangaroo.

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